

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE

NUMBER: 03-1-0192 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 2 02/21/01

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	: LINE ASSEMBLY BOEING	V070-415141

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

LINES DOWNSTREAM OF HELIUM PNEUMATIC CHECK VALVE CV9 CONNECTING THREE-WAY SOLENOID VALVES TO THE LO2 PREVALVE ACTUATOR PORTS AND ANTI-SLAM PORTS, NORMALLY UNPRESSURIZED DURING ASCENT. LINES ARE BETWEEN THE FOLLOWING SOLENOID VALVES AND PNEUMATIC ACTUATORS: LV13 AND LV80 TO PV1, LV15 AND LV81 TO PV2, LV17 AND LV82 TO PV3.

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 6

FUNCTION:

THESE LINES TRANSMIT PNEUMATIC PRESSURE TO THE CLOSING SOLENOIDS (LV13, 15, 17, 80, 81, 82) FOR OPERATION OF THE LO2 PREVALVES (PV1, 2, 3).

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SUBSYSTEM NAME: MAIN PROPULSION

LRU: LO2 PV ANTI-SLAM VALVE SUPPLY LINE ASSY

CRITICALITY OF THIS

ITEM NAME: LO2 PV ANTI-SLAM VALVE SUPPLY LINE ASSY

FAILURE MODE: 1/1

FAILURE MODE:

RUPTURE/LEAKAGE

MISSION PHASE: LO LIFT-OFF

VEHICLE/PAYLOAD/KIT EFFECTIVITY:	102	COLUMBIA
	103	DISCOVERY
	104	ATLANTIS
	105	ENDEAVOUR

CAUSE:

FATIGUE, MATERIAL DEFECTS, IMPROPER BRAZE, DAMAGED/DEFECTIVE JOINT SEAL

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN	A) N/A
	B) N/A
	C) N/A

PASS/FAIL RATIONALE:

A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

MAY PREVENT THE APPLICATION OF CLOSING PRESSURE TO THE LO2 PREVALVE ACTUATORS (REFERENCE FMEA/CIL 03-1-0226).

(B) INTERFACING SUBSYSTEM(S):

MAY RESULT IN THE INABILITY TO MAINTAIN INJECTED HELIUM (PROVIDED BY THE ENGINE HELIUM SUPPLY) AND LO2 PRESSURE AT THE SSME PUMP CAUSING POSSIBLE PUMP OVERSPEED AND CAVITATION AT MECO. MAY RESULT IN UNCONTAINED ENGINE DAMAGE, POSSIBLE AFT COMPARTMENT OVERPRESSURIZATION AND FIRE/EXPLOSIVE HAZARD.

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(C) MISSION:

POSSIBLE LOSS OF CREW/VEHICLE.

(D) CREW, VEHICLE, AND ELEMENT(S):

SAME AS C.

(E) FUNCTIONAL CRITICALITY EFFECTS:

NONE.

-DISPOSITION RATIONALE-

(A) DESIGN:

DESIGNED TO A MINIMUM FACTOR OF SAFETY OF 2.0 PROOF AND 4.0 BURST. THE MECHANICAL FITTINGS (DYNATUBE) ARE MANUFACTURED FROM INCONEL 718. THE TUBE SEGMENTS ARE MANUFACTURED FROM 304L CRES TUBING. THE TUBE SEGMENTS AND FITTINGS ARE CONNECTED TOGETHER BY INDUCTION BRAZING USING A CRES UNION AND A BRAZE ALLOY PREFORM (81.5 AU, 16.5 CU, 2 NI). THE ROCKWELL INTERNATIONAL BRAZE ALLOY WAS SELECTED DUE TO ITS LOWER BRAZING TEMPERATURE REQUIREMENT THAN THE INDUSTRY STANDARD, AIDING IN THE PREVENTION OF EXCESSIVE GRAIN GROWTH AND REDUCING EROSION OF TUBE ENDS.

(B) TEST:

ATP

THE LINE ASSEMBLY IS PROOF PRESSURED TO 1225 PSIG AND LEAK CHECKED AT 750 PSIG AFTER INSTALLATION IN THE VEHICLE.

CERTIFICATION

CERTIFICATION OF THE TUBING INSTALLATION WAS ACCOMPLISHED BY ROCKWELL INTERNATIONAL PER THE "ORBITER TUBING VERIFICATION PLAN SD75-SH-205". 304L CRES TUBING WAS CERTIFIED FOR THE APOLLO PROPULSION SYSTEMS, THE F5E, A-9, C130A, 707, 727, AND 737 AIRCRAFT. THE TUBING WAS QUALIFIED BY SIMILARITY AND BY ANALYSIS FOR ORBITER USAGE EXCEPT FOR FLEXURAL FATIGUE AND RANDOM VIBRATION FOR THE LONG-LIFE ORBITER REQUIREMENTS. DATA FROM THE MISSION DUTY CYCLES CONDUCTED ON MPTA WERE ALSO USED TO CERTIFY TUBING INSTALLATIONS.

DYNATUBE FITTINGS AND SEALS WITH 304L TUBING WERE SUBJECTED TO THE FOLLOWING QUALIFICATION TESTS:

PROOF PRESSURE - PRESSURIZED TO TWO TIMES OPERATING PRESSURE AND HELD FOR 5 MINUTES.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
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EXTERNAL LEAKAGE - LEAK CHECKED AT 1-1/2 TIMES OPERATING PRESSURE. MAXIMUM ALLOWABLE LEAK RATE IS 1×10^{-6} SCCS.

BURST TEST - EXCEEDED 4 TIMES OPERATING PRESSURE.

IMPULSE FATIGUE - 200,000 CYCLES AT A CYCLIC RATE OF 70 +/- 5 CYCLES PER MINUTE FROM ZERO PSIG TO OPERATING PRESSURE TO ZERO PSIG.

FLEXURE FATIGUE - SPECIMENS WERE FILLED WITH HYDRAULIC FLUID AND PRESSURIZED TO OPERATING PRESSURE. THE SPECIMENS WERE THEN TESTED TO 10 MILLION CYCLES OF FLEXURE.

VIBRATION - 7 TEST SPECIMENS WERE SUBJECTED TO 45 MINUTES OF RANDOM VIBRATION AT 0.4 G²/HZ, 30 MINUTES AT 0.7 G²/HZ AND 10 MINUTES AT 0.2 G²/HZ AT AMBIENT PRESSURE AND TEMPERATURE CONDITIONS.

OMRSD

ANY TURNAROUND CHECKOUT IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION

ALL DETAIL HARDWARE IS VERIFIED, BY INSPECTION, INDIVIDUALLY AT THE DETAIL LEVEL ON MANUFACTURING ORDERS, WITH ALL PROCESSES INCORPORATED.

CONTAMINATION CONTROL

CLEANLINESS LEVEL IS VERIFIED TO 100A. CORROSION PROTECTION IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

PARTS PROTECTION FROM DAMAGE AND CONTAMINATION IS VERIFIED. COMPONENTS ARE INSPECTED VISUALLY, DIMENSIONALLY, AND INCREMENTALLY DURING FABRICATION. TUBE AND AXIAL ALIGNMENT OF DYNATUBE FITTINGS ARE VERIFIED. TORQUES ARE VERIFIED. SEALING SURFACE IS VERIFIED BY INSPECTION. MANDATORY INSPECTION POINTS ARE INCLUDED IN THE ASSEMBLY PROCEDURES.

CRITICAL PROCESS

LUBRICATION OF ALL THREADED FLUID FITTING COUPLINGS IS VERIFIED. ELECTRICAL BONDING IS VERIFIED. HEAT TREATMENT AND PART PASSIVATION ARE ALSO VERIFIED.

NON DESTRUCTIVE EVALUATION

RADIOGRAPHIC INSPECTION OF INDUCTION BRAZES IS VERIFIED BY INSPECTION.

TESTING

ATP IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

PACKAGING FOR SHIPMENT VERIFIED BY INSPECTION.

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(D) FAILURE HISTORY:

CURRENT DATA ON TEST FAILURE, FLIGHT FAILURE, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATABASE.

(E) OPERATIONAL USE:

NO CREW ACTION CAN BE TAKEN.

- APPROVALS -

S&R ENGINEERING	: W.P. MUSTY	:/S/ W. P. MUSTY
S&R ENGINEERING ITM	: P. A. STENGER-NGUYEN	:/S/ P. A. STENGER-NGUYEN
DESIGN ENGINEERING	: LEE DURHAM	:/S/ LEE DURHAM
MPS SUBSYSTEM MGR.	: TIM REITH	:/S/ TIM REITH
MOD	: JEFF MUSLER	:/S/ JEFF MUSLER
USA SAM	: MIKE SNYDER	:/S/ MIKE SNYDER
USA ORBITER ELEMENT	: SUZANNE LITTLE	:/S/ SUZANNE LITTLE
NASA SR&QA	: BILL PRINCE	:/S/ BILL PRINCE